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AN INDUSTRY PUTS THE TEXAS COORDINATE SYSTEM TO WORK

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SURVEYING AND MAPPING DIVISION

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AN INDUSTRY PUTS THE TEXAS COORDINATE SYSTEM TO WORK

H. P. Cooper,¹ J. M. ASCE

In the first part of this paper I will tell you why the Texas Division of The Dow Chemical Company decided to locate its property in the Texas Coordinate System and how additional second-order control stations were set. The second part will explain our local situation, why additional control stations were necessary, and how these stations are being used.

The relationship between the Texas Division of The Dow Chemical Company and the Texas Coordinate System began in the fall of 1952 when Dr. A. P. Beutel, General Manager of our Texas Division, read an article supporting the use of controlled surveying and coordinate systems. That article, with the request that the possibilities of this type of surveying be investigated, was passed down the line to H. D. Smith, a surveyor in our Engineering Department.

Mr. Smith, a licensed State Land Surveyor in Texas, was thoroughly familiar with the Texas Coordinate System and the advantages and value of controlled surveying. Thus Mr. Smith was given the opportunity of preparing a report to be presented to top management.

This was done, and it resulted in management's approval of the use of the Texas Coordinate System. I would like to read excerpts from this report to you because it is a typical example of how any state coordinate system can sell itself to industry if properly presented.

A. Advantages of using this system of surveying:

1. It affords a means of permanently locating the position of a point on the surface of the earth. (Thereby affording the means of perpetuating its position positively within limit of original measurement.)
2. It provides an accurate system of determining true direction (Azimuth and/or Bearing) at any point on the surface of the earth accessible by man for such purpose.
3. It furnishes a scheme whereby the relationship between remote areas is definitely known, and may be utilized for several purposes.
4. It attains very accurate, unified, coordinated, and controlled results over great areas by plane surveying field operations of an accuracy consistent with any good second-order survey.
5. It supplies a common language for all engaged in the preparation of real property descriptions once its essentials are understood.
6. It is the standard system for surveying in Texas.
7. Where records of surveys, maps, plats, and descriptions are desired to pass on to posterity, it is not only practical but necessary to use the system for economy in future work. It enables us to hand down, not only good information of great value, but also a progressive network that will reduce the amount of surveying required in the future.

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B. Disadvantages of using this system of surveying:

The initial cost will be higher because the initiating surveys will require some additional work in both field and office. This cost, as time passes, will become less and less, until it reverses and becomes a very real saving over continuing our present system.

This is the substance of the report that sold our Texas Division Management on the use of the Texas Coordinate System.

After this decision had been made, the responsibility for initiating and putting this system into effect was assigned to Mr. T. A. Munson and me, working as Mr. Munson's assistant. The first problem which confronted us was setting additional second-order control stations to bring the coordinate system into the area. After studying this problem and discussing it with other engineers at technical society meetings, we decided to attempt to train our contract survey crew for precise work and have them establish the control stations. These stations were to be set by triangulation in open prairie and by traverse in wooded areas.

Before actual field work was begun in carrying out this plan, I attended the Second Annual Texas Surveyors Association Short Course held in Austin, Texas during October, 1953. At this meeting Mr. Harry A. Seran, Consulting Geodesist, of San Antonio, Texas, presented a paper entitled "The 1953 Control Survey of San Antonio, Texas," which gave a summary of how the U. S. Coast and Geodetic Survey had established approximately 125 first-order control stations for that city. In explaining why the U. S. Coast and Geodetic Survey was able to do this work for a city, Mr. Seran quoted the full text of an act approved by Congress August 6, 1947 entitled "An Act to Define the Functions and Duties of the Coast and Geodetic Survey and For Other Purposes."² Of great interest to me was Section (5) of this act which reads as follows: "The director is authorized to enter into cooperative agreements with, and to receive and expend funds made available by any State or Subdivision thereof, or any public or private organization, or individual, for surveys or investigations authorized herein, or for performing related surveying and mapping activities, including special-purpose maps, and for the preparation and publication of the results thereof."

Having learned at this meeting that the U. S. Coast and Geodetic Survey had authority to work for any private organization, we immediately contacted the Washington office of the Survey.

As a result of favorable preliminary contacts, Mr. Lansing G. Simmons visited our plant at Freeport, Texas on December 2, 1953. After examining our problem, Mr. Simmons stated that the Survey would probably be interested in doing this work for us and, if so, that we might be able to get it done in the early spring of 1954 since they would have a field party working in our area at that time. Mr. Simmons further suggested that we submit an inquiry to the Director of the U. S. Coast and Geodetic Survey giving the scope of our proposed project and locations of stations to be established, requesting that all work be done by the Survey subject to reimbursement by The Dow Chemical Company.

To give you an example of the quick and efficient attention the U. S. Coast and Geodetic Survey gave us in this matter, let me quote some dates. Our inquiry was mailed on December 4, 1953, and on December 13, 1953, less than ten days later, we received a form of agreement from the U. S. Coast and Geodetic Survey. This agreement, which was merely a statement of what each

2. See appendix for full text of Act.

party agreed to do, was wholly acceptable to Dow and was made official on January 14, 1954, by signatures of both parties involved.

Field work was begun on January 26, 1954 when Mr. R. A. Pryce, who was Party Chief of all field work done for Dow, arrived in Freeport, Texas. After two weeks of reconnaissance work by Mr. Pryce, six more members of the Survey moved in. A party of seven men, including one observer, one recorder, and five builders, was maintained throughout the length of the project. After eleven weeks 20 second-order control stations, each with an azimuth reference, had been established and the field work was complete. Within four weeks after the completion of the field work, we had received the computations and adjustment of our survey and a final list of the geographic positions and plane coordinates of the stations established.

The estimated cost of this work, if done by our contract survey crews, indicated that we realized a very substantial savings by having the U. S. Coast and Geodetic Survey do this work. Thus we economically obtained in our area a group of second-order control stations set by an organization whose accuracy is highly respected.

In order to explain our local situation and why additional control stations were necessary, reference is made to Exhibit "A". This Exhibit is a portion of the U. S. Coast and Geodetic Survey's triangulation diagram showing triangulation stations along the Gulf Coast from San Luis Pass to East Matagorda Bay. This portion shows about 15 miles of beach and extends inland up the Brazos River approximately 20 miles. Towns included in this area are Freeport, Velasco, Clute City, Lake Jackson, and Brazoria.

Triangulation stations previously set by the U. S. Coast and Geodetic Survey in this area consisted basically of two triangulation arcs. One arc runs parallel and adjacent to the coast line and includes stations Mule, Levee, Keg, West 2, Bend, Light, Skeet, Will, and Slough. The average spacing between these stations is approximately 4 to 6 miles. The second arc, with an average spacing between stations of approximately 10 miles, also runs parallel to the coast and is located further inland. Stations in this arc are McNeel, Brazoria, Jones, Pharr, and Angleton which doesn't show on the exhibit.

The crosshatched areas on this exhibit cover the areas in which Dow owns about 70% of the land. In order to locate any tract of land in the Northwestern half of the area owned by Dow, it would have been necessary to begin the survey at station Pharr, run a traverse for approximately 8 miles, survey the tract, and then continue the traverse for another 8 miles to close the survey on the control station at Brazoria. The same situation existed in the southeastern half of the area except that the 8 miles could be reduced to about 4 miles. Realizing how impractical, expensive, and inaccurate such a procedure would be in locating Dow land by the Texas Coordinate System, we decided to establish additional stations.

On the exhibit, stations established by the U. S. Coast and Geodetic Survey for Dow are indicated by black dots and connected with broken lines. Maximum spacing between these stations was held to approximately two miles, a distance which the average land surveyor can traverse with second-order accuracy when necessary.

Fifteen of the eighteen stations shown on Exhibit "A" are on Dow-owned property. Thirteen of these are adjacent to all-weather roads and will be accessible under any weather conditions. The remaining five stations are accessible by dirt roads and can be reached only in dry weather.

The field survey was begun by setting towers at three existing stations—Angleton, Brazoria, and Jones, and one new station, Salt. These four stations

formed a first-order quadrangle. Work was then begun at Brazoria and progressed in a Southeasterly direction through the new stations forming a triangulation arc of single triangles. New stations adjacent to Jones and Salt are tied into those stations and the lower end of the arc terminates at three existing stations, West 2, Well, and Bend. Thus each end and the middle of the new arc are tied into first-order control.

Two more stations were set approximately 8 miles north of Angleton on Dow-owned land at a 2000-acre fresh water reservoir.

In Wharton County the U. S. Coast and Geodetic Survey made minor changes in their master plan for the unsurveyed area in that county and located two stations adjacent to Dow-owned Natural Gas Metering Stations. They were already working in this area and these stations were a part of their regular coverage and were established by the Survey without cost to Dow.

Since the completion of this project our use of these stations has been confined to the salt grass prairie land that extends from the Gulf inland to Plant "B". In 1909 all of this area was subdivided into 5 acre tracts and sold by a mail order procedure. Dow now owns approximately 900 of these tracts. Exhibit "B" shows a typical subdivision which contains 408 tracts. Due to its very low material value, the majority of this land has never been surveyed and marked. Therefore our problem consists of locating and marking these tracts and also obtaining coordinate positions of tract corners.

The first step in solving this problem is locating all existing markers and lines of occupation. Then a series of control traverses are run through the subdivision and through all evidence found on the ground. These control traverses follow along tract lines between two control stations as shown by the solid lines from Station Airport to Station Plant "B" in Exhibit "B". These control traverses are then tied together by traverses along tract lines as shown by the broken lines. After these traverses have been balanced and corrected to close on the control stations, the whole subdivision is positioned so that it agrees with a majority of the evidence found. Dow-owned tracts are then located and marked and coordinates of tract corners are computed with a minimum of additional field work.

Our evaluation of the work done for us by the U. S. Coast and Geodetic Survey is high. We are well pleased with all phases of the work, and recommend this method of obtaining additional control in any area where it is needed. We believe the Texas Division of The Dow Chemical Company will for many years reap benefits from the decision to use the Texas Coordinate System.

APPENDIX

1. "An Act to Define the Functions and Duties of the Coast and Geodetic Survey and for other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That, to provide charts and related information for the safe navigation of marine and air commerce, and to provide basic data for engineering and scientific purposes and for other commercial and industrial needs, the Director of the Coast and Geodetic Survey, hereinafter referred to as the Director, under direction of the Secretary of Commerce, is authorized to conduct the following activities in the United States, its Territories and possessions:

"(1) Hydrographic and topographic surveys of coastal waters and land areas (including surveys of offlying islands, banks, shoals, and other off-shore areas);

"(2) Hydrographic and topographic surveys of lakes, rivers, reservoirs and other inland waters not otherwise provided for by statute:

"(3) Tide and current observations:

"(4) Geodetic control surveys:

"(5) Field surveys for aeronautical charts:

"(6) Geomagnetic, seismological, gravity, and related geophysical measurements and investigations, and observations for the determination of variation in latitude and longitude.

"Sec. (2). In order that full public benefit may be derived from the operations of the Coast and Geodetic Survey by the dissemination of data resulting from the activities herein authorized and of related data from other sources, the Director is authorized to conduct the following activities:

"(1) Analysis and prediction of tide and current data;

"(2) Processing and publication of data, information, compilations, and reports;

"(3) Compilation and printing of aeronautical charts of the United States, its Territories and possessions; and, in addition, the compilation and printing of aeronautical charts covering international airways as are required primarily by United States civil aviation;

"(4) Compilation and printing of nautical charts of the United States, its Territories and possessions;

"(5) Distribution of aeronautical charts and related navigational publications required by the United States civil aviation;

"(6) Distribution of nautical charts and related navigational publications for the United States, its Territories and possessions.

"Sec. (3). To provide for the orderly collection of geomagnetic data from domestic and foreign sources, and to assure that such data shall be readily available to Government and private agencies and individuals, the Coast and Geodetic Survey is hereby designated as the central depository of the United States Government for geomagnetic data, and the Director is authorized to collect, correlate, and disseminate such data.

"Sec. (4). To improve the efficiency of the Coast and Geodetic Survey and to increase engineering and scientific knowledge, the Director is authorized to conduct development work for the improvement of surveying and cartographic methods, instruments, and equipments; and to conduct investigations and research in geophysical sciences (including geodesy, oceanography, seismology and geomagnetism).

"Sec. (5). The Director is authorized to enter into cooperative agreements with, and to receive and expend funds made available by any State or subdivision thereof, or any public or private organization, or individual, for surveys or investigations authorized herein, or for performing related surveying and mapping activities, including special purpose maps, and for the preparation and publication of the results thereof.

"Sec. (6). The Director is authorized to contract with qualified organizations for the performance of any part of the authorized functions of the Coast and Geodetic Survey when he deems such procedure to be in the public interests.

"Sec. (7). The Secretary of Commerce is hereby authorized to accept and utilize gifts or bequests of money and other real or personal property for the purpose of aiding or facilitating the work of the Coast and Geodetic Survey and such gifts and bequests and the income therefrom shall be exempt from Federal Taxes.

"Sec. (8). The President is authorized to cause to be employed such of the public vessels as he deems it expedient to employ, and to give such instructions for regulating their conduct as he deems proper to carry out the provisions of this Act.

"Sec. (9). There are hereby authorized to be appropriated such funds as may be necessary to acquire, construct, maintain and operate ships, stations, equipment, and facilities for such other expenditures, including personal services at the seat of government and elsewhere and including the erection of temporary observatory buildings and leases of sites therefor, as may be necessary for the conduct of the activities herein authorized.

"Approved August 6, 1947."

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The technical papers published in the past year are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

VOLUME 79 (1953)

DECEMBER: 359(AT), 360(SM), 361(HY), 362(HY), 363(SM), 364(HY), 365(HY), 366(HY), 367(SU)^c, 368(WW)^c, 369(IR), 370(AT)^c, 371(SM)^c, 372(CO)^c, 373(ST)^c, 374(EM)^c, 375(EM), 376(EM), 377(SA)^c, 378(PO)^c.

VOLUME 80 (1954)

JANUARY: 379(SM)^c, 380(HY), 381(HY), 382(HY), 383(HY), 384(HY)^c, 385(SM), 386(SM), 387(EM), 388(SA), 389(SU)^c, 390(HY), 391(IR)^c, 392(SA), 393(SU), 394(AT), 395(SA)^c, 396(EM)^c, 397(ST)^c.

FEBRUARY: 398(IR)^d, 399(SA)^d, 400(CO)^d, 401(SM)^c, 402(AT)^d, 403(AT)^d, 404(IR)^d, 405(PO)^d, 406(AT)^d, 407(SU)^d, 408(SU)^d, 409(WW)^d, 410(AT)^d, 411(SA)^d, 412(PO)^d, 413(HY)^d.

MARCH: 414(WW)^d, 415(SU)^d, 416(SM)^d, 417(SM)^d, 418(AT)^d, 419(SA)^d, 420(SA)^d, 421(AT)^d, 422(SA)^d, 423(CP)^d, 424(AT)^d, 425(SM)^d, 426(IR)^d, 427(WW)^d.

APRIL: 428(HY)^c, 429(EM)^c, 430(ST), 431(HY), 432(HY), 433(HY), 434(ST).

MAY: 435(SM), 436(CP)^c, 437(HY)^c, 438(HY), 439(HY), 440(ST), 441(ST), 442(SA), 443(SA).

JUNE: 444(SM)^e, 445(SM)^e, 446(ST)^e, 447(ST)^e, 448(ST)^e, 449(ST)^e, 450(ST)^e, 451(ST)^e, 452(SA)^e, 453(SA)^e, 454(SA)^e, 455(SA)^e, 456(SM)^e.

JULY: 457(AT), 458(AT), 459(AT)^c, 460(IR), 461(IR), 462(IR), 463(IR)^c, 464(PO), 465(PO)^c.

AUGUST: 466(HY), 467(HY), 468(ST), 469(ST), 470(ST), 471(SA), 472(SA), 473(SA), 474(SA), 475(SM), 476(SM), 477(SM), 478(SM)^c, 479(HY)^c, 480(ST)^c, 481(SA)^c, 482(HY), 483(HY).

SEPTEMBER: 484(ST), 485(ST), 486(ST), 487(CP)^c, 488(ST)^c, 489(HY), 490(HY), 491(HY)^c, 492(SA), 493(SA), 494(SA), 495(SA), 496(SA), 497(SA), 498(SA), 499(HW), 500(HW), 501(HW)^c, 502(WW), 503(WW), 504(WW)^c, 505(CO), 506(CO)^c, 507(CP), 508(CP), 509(CP), 510(CP), 511(CP).

OCTOBER: 512(SM), 513(SM), 514(SM), 515(SM), 516(SM), 517(PO), 518(SM)^c, 519(IR), 520(IR), 521(IR), 522(IR)^c, 523(AT)^c, 524(SU), 525(SU)^c, 526(EM), 527(EM), 528(EM), 529(EM), 530(EM)^c, 531(EM), 532(EM)^c, 533(PO).

NOVEMBER: 534(HY), 535(HY), 536(HY), 537(HY), 538(HY)^c, 539(ST), 540(ST), 541(ST), 542(ST), 543(ST), 544(ST), 545(SA), 546(SA), 547(SA), 548(SM), 549(SM), 550(SM), 551(SM), 552(SA), 553(SM)^c, 554(SA), 555(SA), 556(SA), 557(SA).

DECEMBER: 558(ST), 559(ST), 560(ST), 561(ST), 562(ST), 563(ST)^c, 564(HY), 565(HY), 566(HY), 567(HY), 568(HY)^c, 569(SM), 570(SM), 571(SM), 572(SM)^c, 573(SM)^c, 574(SU), 575(SU), 576(SU), 577(SU), 578(HY), 579(ST), 580(SU), 581(SU), 582(Index).

c. Discussion of several papers, grouped by Divisions.

d. Presented at the Atlanta (Ga.) Convention of the Society in February, 1954.

e. Presented at the Atlantic City (N.J.) Convention in June, 1954.

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